



Navy Strategy for the Future

Telescoping Systems Strategy for Mission Success

The US Navy and Marine Corps Corporate Laboratory

NOGAPS: (Fleet Numerical)

- Global coverage
- 1-10d forecaster guidance

COAMPS: (Fleet Numerical)

- High resolution, nested regional coverage
- 0-72h forecaster guidance

DAMPS: (Regional Centers)

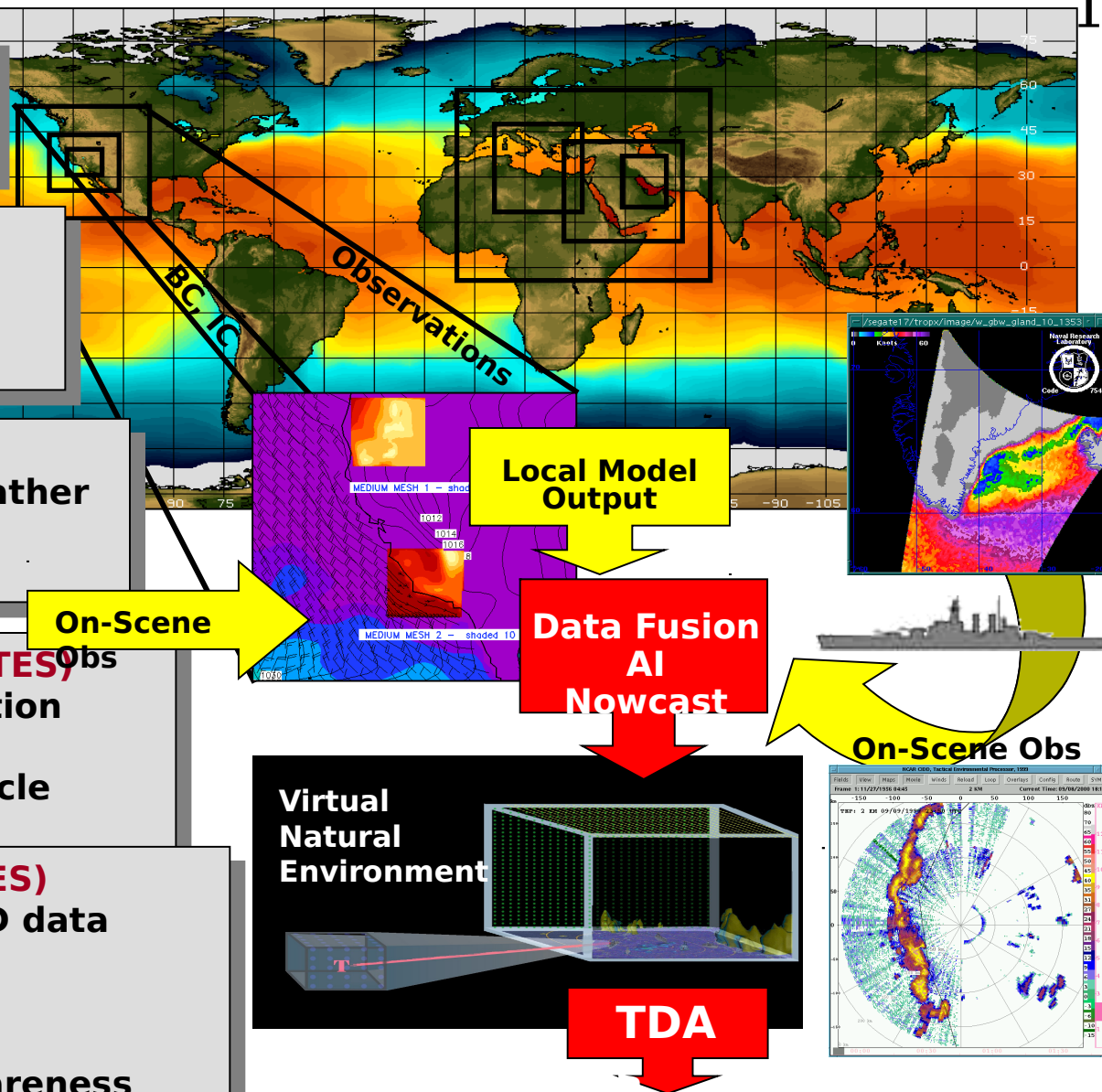
- On-scene tactical-scale weather
- 0-48h forecaster guidance
- Web enabled

COAMPS-OS: (Shipboard-NITES)

- Battlegroup data assimilation system
- 6-12h data assimilation cycle
- Web enabled

Nowcast: (Shipboard-NITES)

- Real-time, automatic, 4D data fusion
- Warfighter time & space requirements
- Common situational awareness





Core Technology Team

Mike Frost (CSC) - Team Leader

Craig Kunitani (Pangaea) - Software Architect

Marie White (Pangaea)

Ramesh Mantri (CSC)

Jennifer Strahl (SAIC)

NRL

Allen Zhao

Gary Love

Rosemary Lande

Larry Phegley

Satellite Applications Section

Mesoscale Modeling Section

Data Assimilation Section

Collaboration / Coordination

NCAR

University of Oklahoma/NSSL

MIT Lincoln Labs

Transition Path

SPAWAR - NITES



Prototype Development Progress

- Java Applet
- Java Servlets and package of servlet classes
- Package of objects shared by server and client
- Run-time database using Lightweight Directory Access Protocol (LDAP)
- Folders and tabs stored in LDAP with user context settings

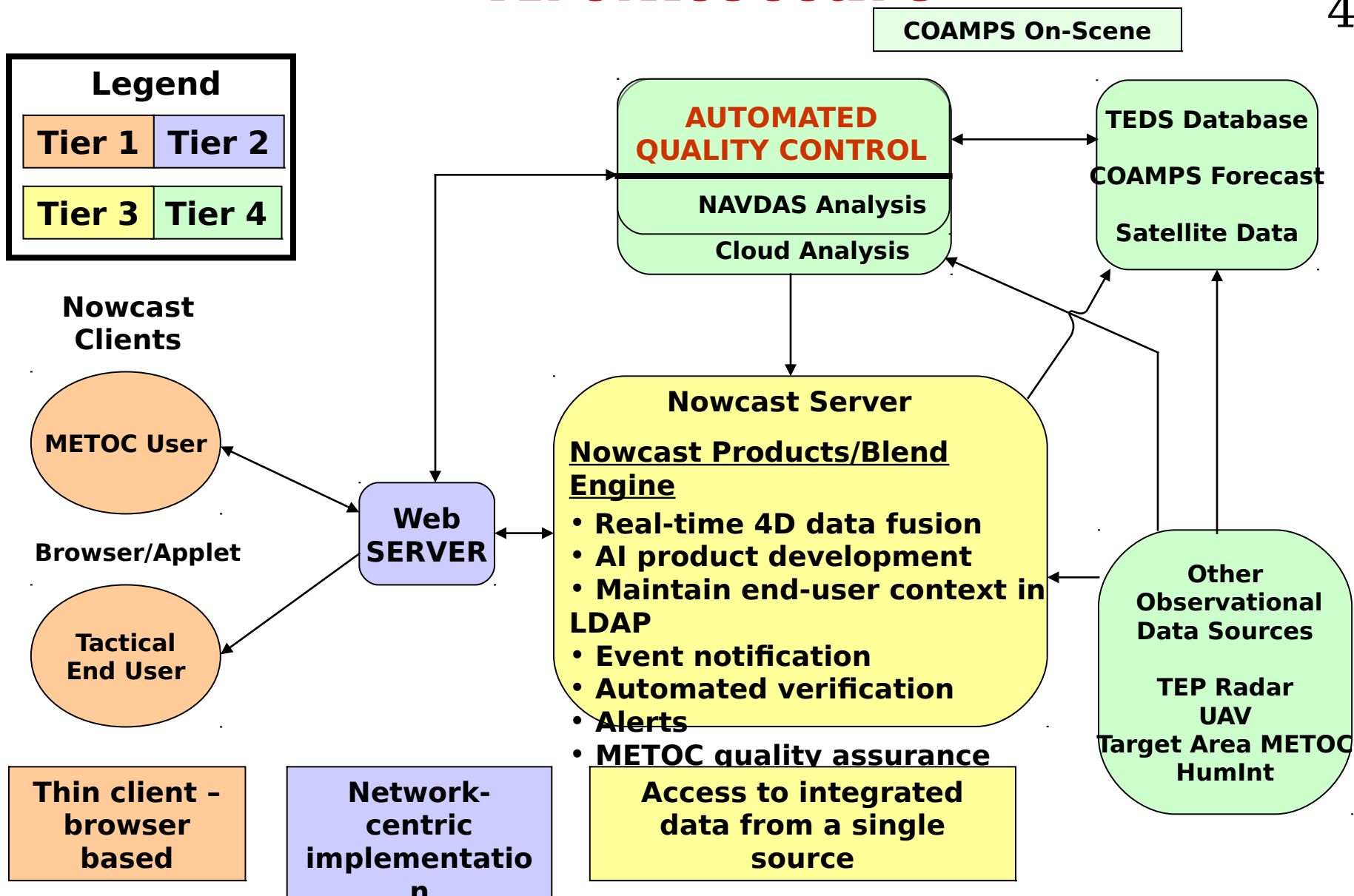
Product Development Progress

- 5 min global obs from TEDS
- 10 min radar data
- 15 min satellite data from Terascan
- NCAR C&V cycling every 15 min
- ADAS cycling hourly on COAMPS fields
- COAMPS run twice a day
- Visualization applications to generate graphical products from COAMPS, ADAS, and NCAR C&V
- Satellite interface for ADAS and NCAR C&V



Nowcast Four-Tier Internet Architecture

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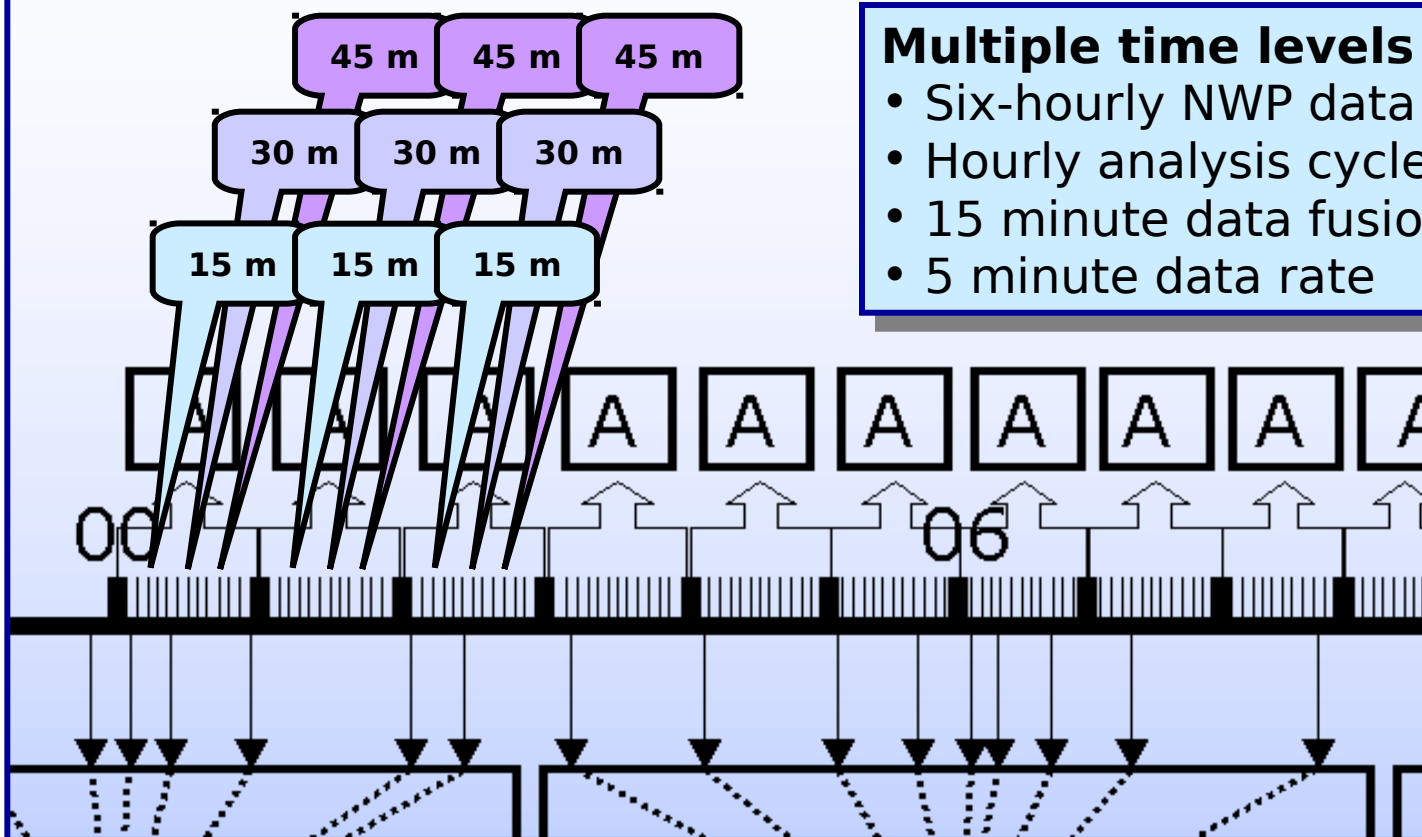
FOR THE NEXT GENERATION NAVY NOWCAST

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- Use hourly analyses as background conditions
- Intermediate cycle for AI data fused product generation (approximately every 15 minutes)

Multiple time levels

- Six-hourly NWP data assimilation cycle
- Hourly analysis cycle
- 15 minute data fusion process
- 5 minute data rate

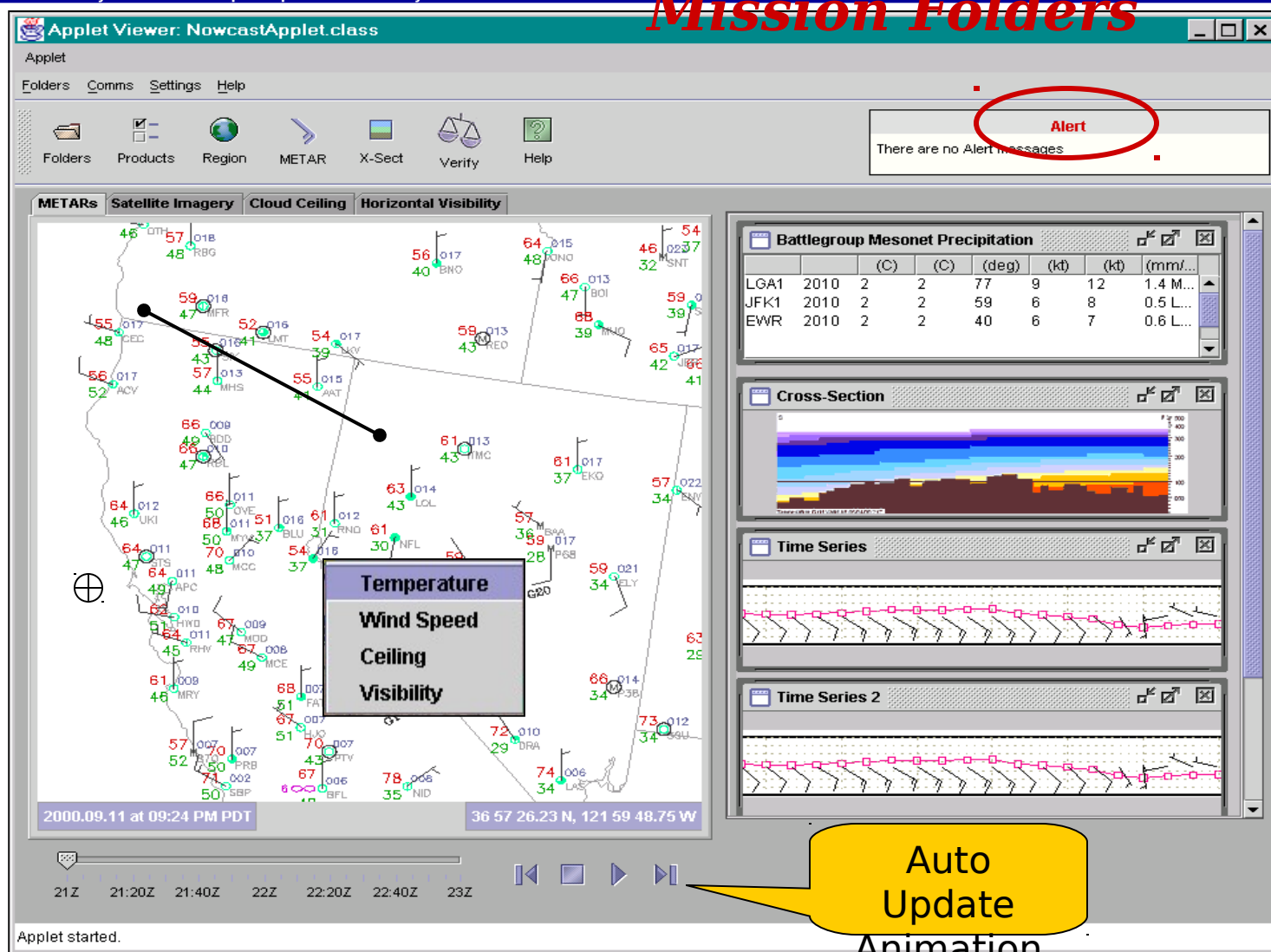




Nowcast Web-Based Applet Viewer

Products Are Organized by the End User into Mission Folders

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Air Defense Folder

- EM Propagation
- Sea State

Strike Folder

- Winds
- Cloud Tops/Bases
- Visibility
- Icing

TLAM Folder

- Winds/Temps Enroute
- Thunderstorms
- Sea State

Bridge Folder

- Wind Shifts/Seas
- Thunderstorms
- Icing and Turbulence

Pilot Folder

- Mission Rehearsal
- 3D Rendering Enroute
- Target Area Weather

CATC Folder

- Ceiling and Visibility
- Thunderstorms

METOC Folder

- Quality Assurance
- Alerts
- User Profiles

Tab: Region, two product layers, data, overlays



Region Selection World - Tactical Views

The US Navy and Marine Corps Corporate Laboratory

- Rubber band
- Zoom in / out
- Change projection
- Predefine regions
- Share maps
- Desire access to a network GIS map server
- Need bounding areas for products and data sets

The screenshot shows a Java Applet Window titled "Select Region". It features a map of the United States with a yellow rubber band highlighting a rectangular region in the central part of the country. The map includes latitude and longitude coordinates. To the right of the map, there are two tabs: "Pre-Defined Regions" and "User Defined Regions". Under "Pre-Defined Regions", there is a list box with the following options: "Global", "Greylock", "MOUT", and "SanDiego_3". Below the list box, there are four buttons: "Zoom In", "Zoom Out", "Reset to Initial Settings", and "Save As User-Defined Region". At the bottom of the window, there is a "Map Options" section with checkboxes for "COAMPS & AOR", "Ship Location", "Large Water Bodies", "Topography", and "Political Borders". The "COAMPS & AOR", "Large Water Bodies", and "Political Borders" checkboxes are checked. Below the "Map Options" section, there is a text box with the following text: "Select a pre-defined region of interest. To refine region, rubberband an area and click 'Zoom In.' When completed with region and option selections, click 'Exit with New Settings.' Products will be displayed for new region and Map Options." At the bottom right of the window, there are two buttons: "Cancel" and "Exit with New Settings". The status bar at the bottom of the window reads "Java Applet Window".

2000.09.11 at 09:30 PM PDT 35 18 40.28N 088 58 15.84W

Map Options:

- ☒ COAMPS & AOR
- ☐ Ship Location
- ☒ Large Water Bodies
- ☐ Topography
- ☒ Political Borders

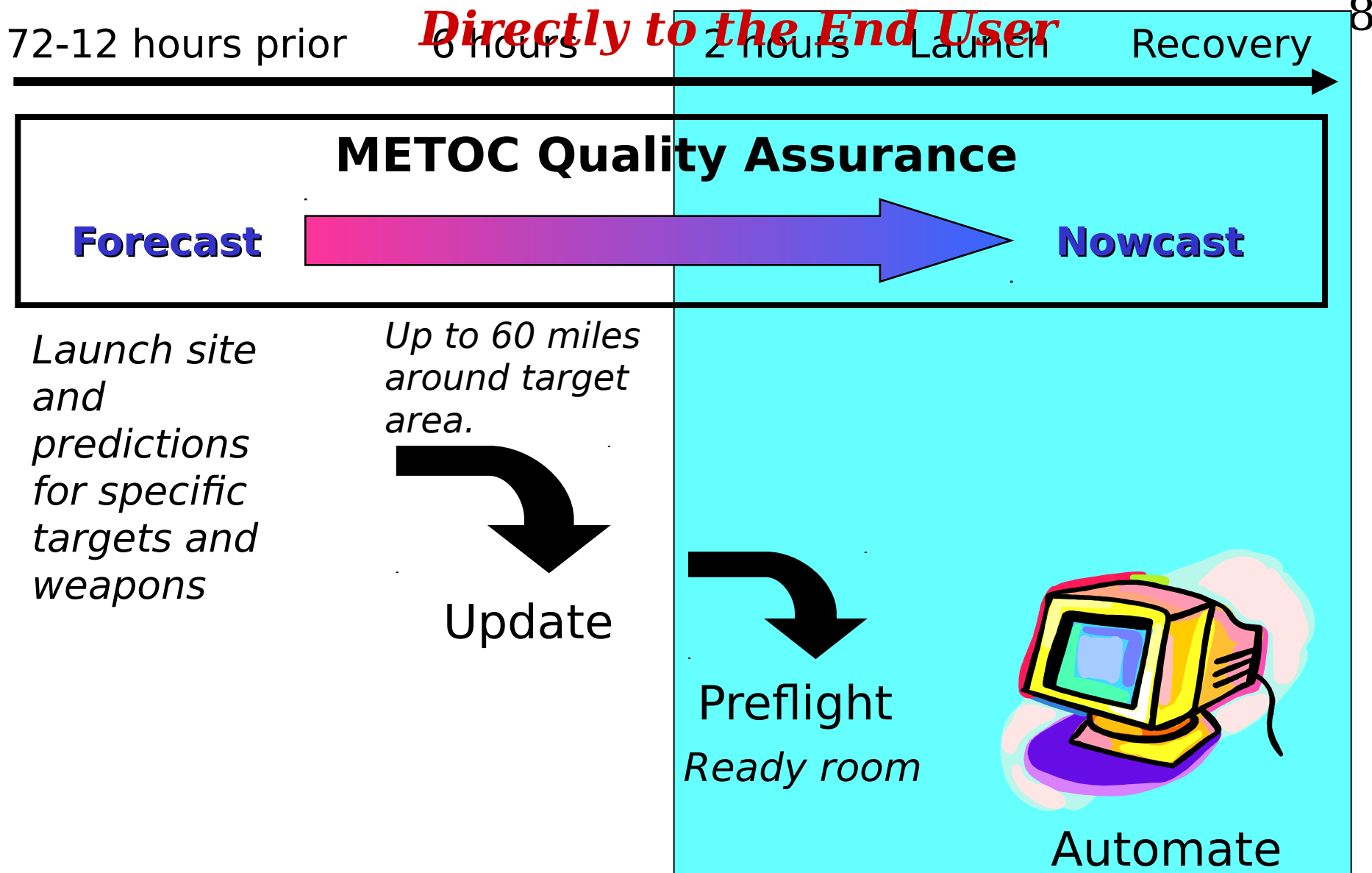
Select a pre-defined region of interest. To refine region, rubberband an area and click "Zoom In." When completed with region and option selections, click "Exit with New Settings." Products will be displayed for new region and Map Options.

Cancel Exit with New Settings



Automatic Update of Time Critical Information

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Data	Kbits/ sec	Kbits/sec (Compressed)	Data Type	Frequency	Origin
From shore to CV/CVN/AGF/LH					
Conventional	0.083	(75%) 0.021	Alpha text	Continuous	Shore
Satellite	0.356	(50%) 0.178	Binary BUFR	Continuous (30 min)	Shore
Target Area	0.226	(50%) 0.113	Binary	Continuous	Shore
LBC (45 X 45 deg)	20.62	(50%) 10.31	Binary GRIB	Twice a day (1 hr)	Shore
Total	21.3	10.6			
CV/CVN/AGF/LH from all ships					
Moriah	0.279	(50%) 0.140	Binary	Continuous (5 min)	All Ships
TEP	56.49	(50%) 28.24	Binary	Continuous (5 min)	AEGIS Ships
Products	214.4	(0.0%) 214.4	Binary images	Continuous (5 min)	CV/CVN/AGF/LH
Total	271.2	242.8			
Individual ships (customers) except TEP equipped					
Moriah/10	0.028	(50%) 0.014			
Products/10	21.44	(0.0%) 21.44			
Total	21.5	21.5			
TEP equipped ships					
TEP	56.49	(50%) 28.24			
Moriah/10	0.028	(50%) 0.014			
Products/10	21.44	(0.0%) 21.44			
Total	78.0	49.7			

COAMPS-OS Estimates
10.6 kbits/sec (compressed)
to large ships twice a day for 1
hour duration

Nowcast Estimates
Large ships - 242.8 kbits/sec
Small ship - 21.5 kbits/sec
TEP ships - 49.7 kbits/sec



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- ① Horizontal Visibility, Cloud Ceiling, and Flight Category
- ① Temperature, Humidity, Precipitation Intensity, and Heat Index
- ① Low-Level Winds and Winds Aloft
- ① Density Altitude and Altimeter Setting
- ① Cloud Location, Top, Base, Layers and Fraction

- ② Composite Radar/Satellite Storm Animation
- ② Thunderstorm Autonowcaster
- ② Storm Cell Location, Movement and Intensity
- ② “Stoplight” Operational Decision Matrix
- ② Electromagnetic Duct Height and Propagation Conditions

- ③ Wind Shear and Microburst
- ③ Extent of In-Flight Icing
- ③ Extent of In-Flight Turbulence
- ③

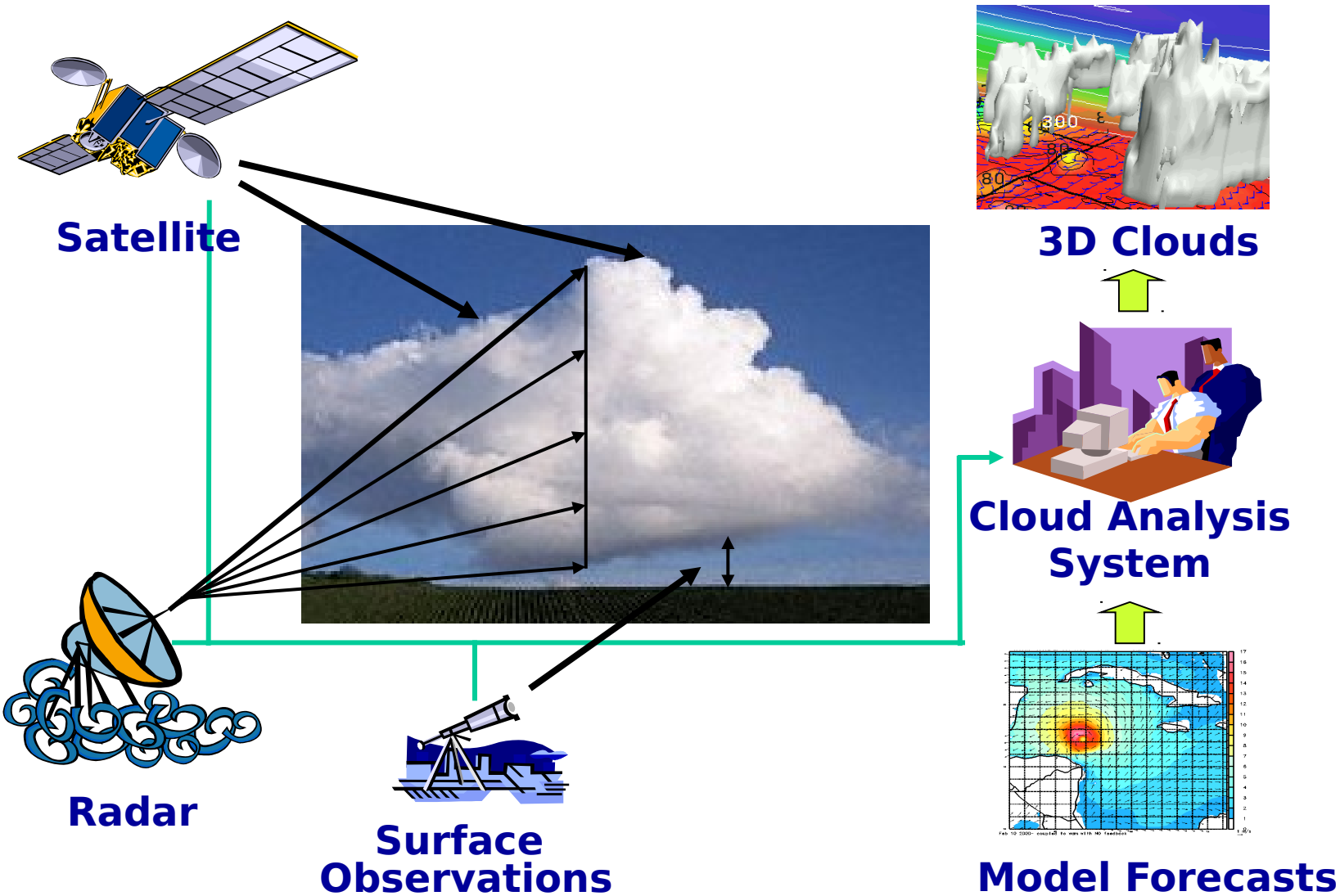


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ADAS Cloud Analysis System

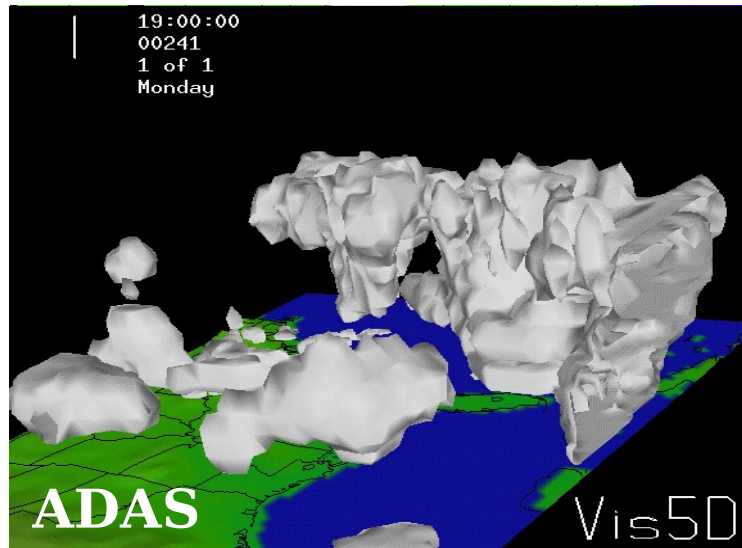
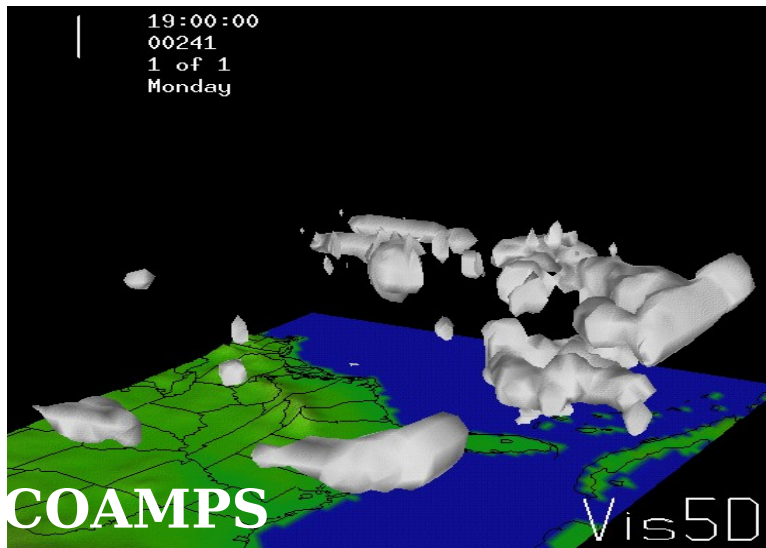
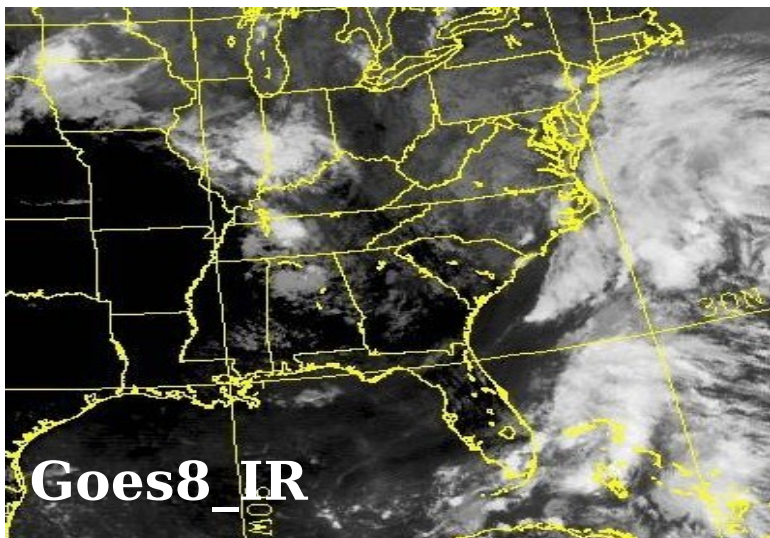




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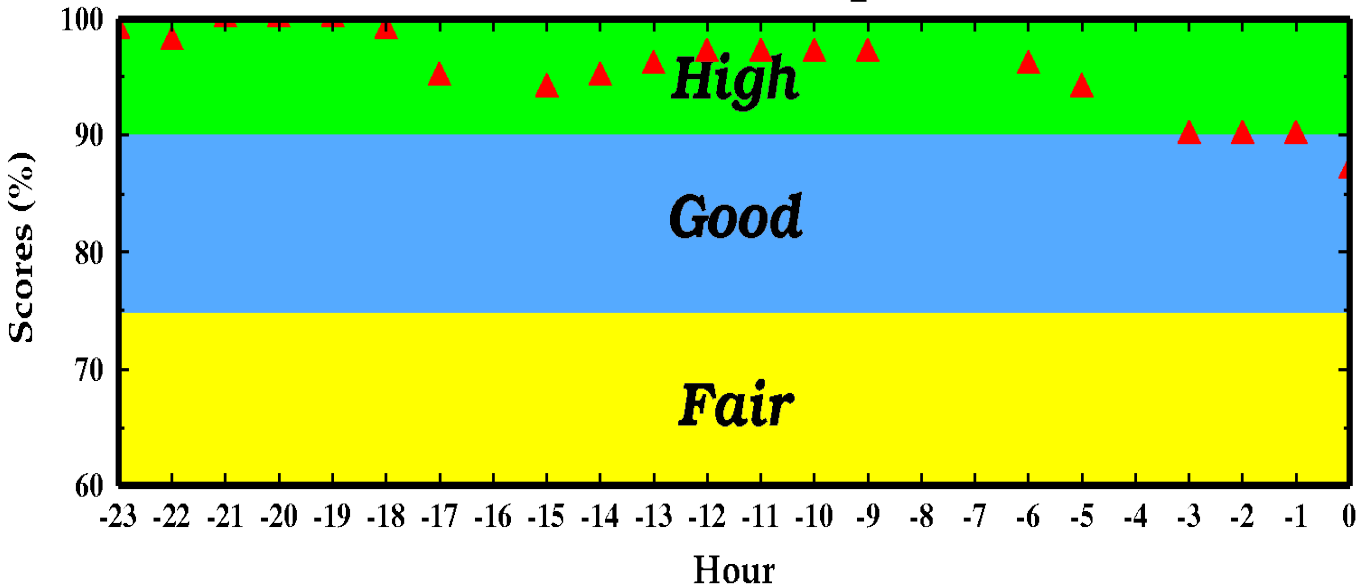
19Z 28 August 2000



**Example of Confidence Level from ADAS Cloud Product
Verification/Monitoring System. Additional information is
available to Forecasters and Developers**

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**Cloud Confidence Level From ADAS for Last 24 Hours
(Percent correct of total predicted cloud)**

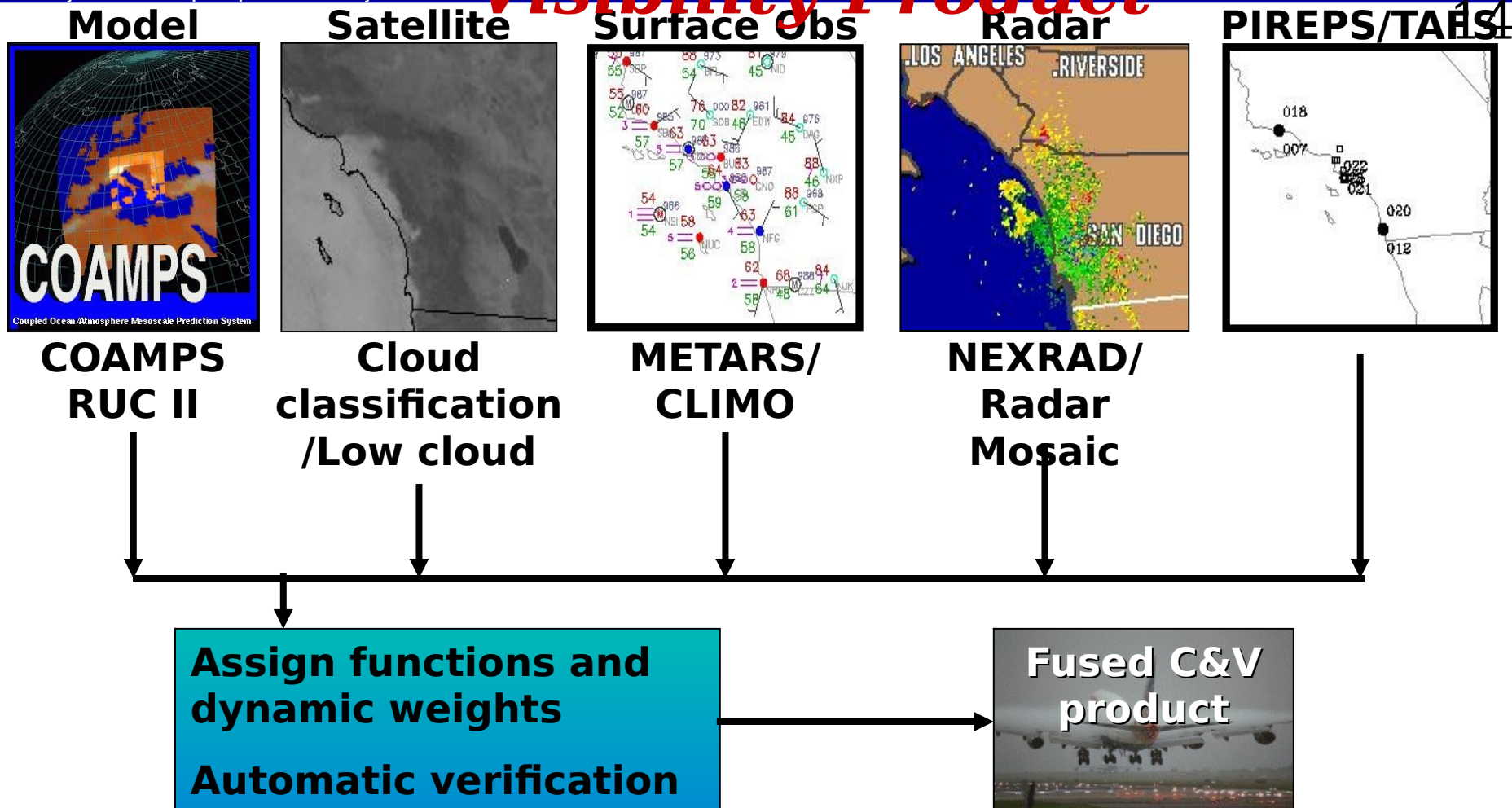


Time at T=0: 17 UTC February 20, 2001



NCAR Fuzzy Logic Ceiling & Visibility Product

The US Navy and Marine Corps Corporate Laboratory

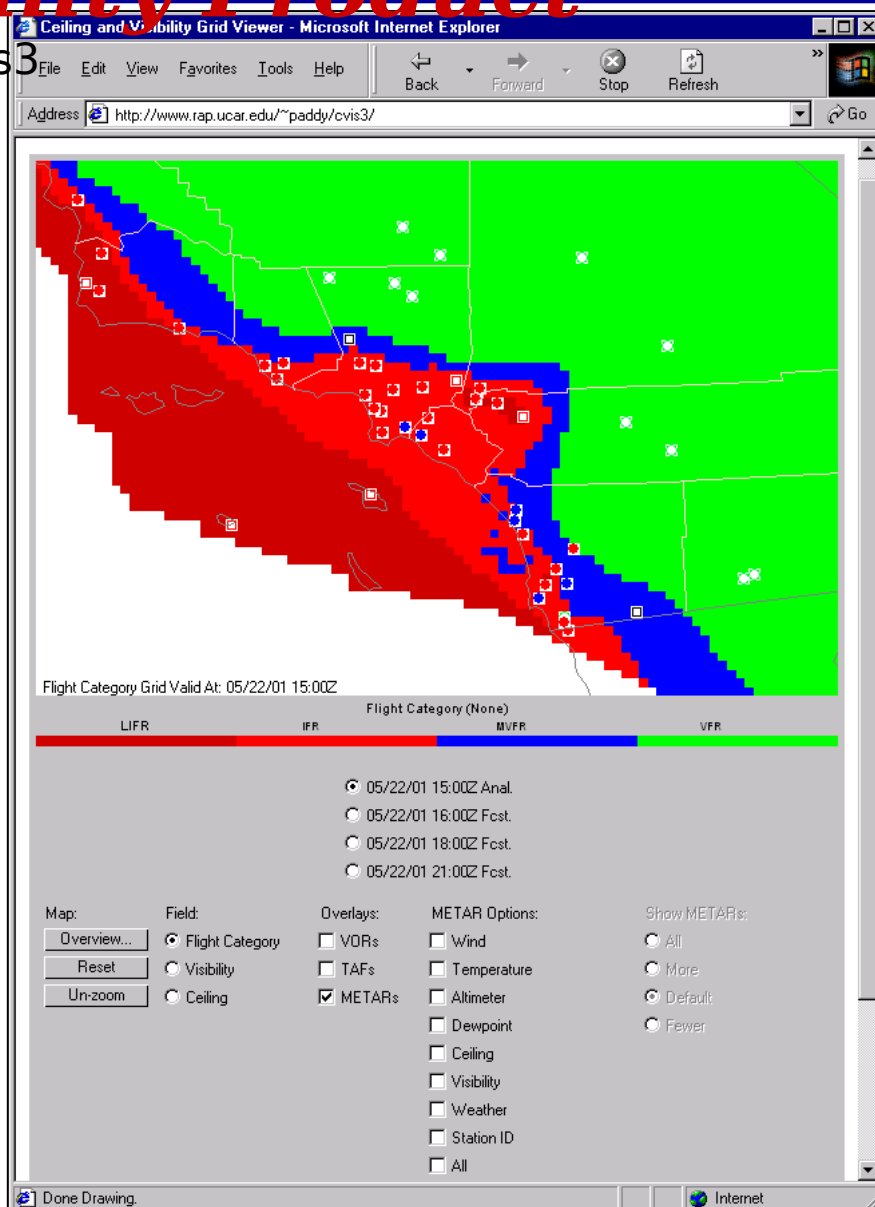


Evaluation 1 June – 31 August, 2000 at NWS Oxnard, NAWC Pt. Mugu, FAA Palmdale, NWS San Diego, and NPMOC San Diego



NCAR Fuzzy Logic Ceiling & Visibility Product

<http://www.rap.ucar.edu/~paddy/cvis3>





Ceiling & Visibility Evaluation

The US Navy and Marine Corps Corporate Laboratory

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Ceiling and Visibility Evaluation Form - Microsoft Internet Explorer

Address: <http://www.rap.ucar.edu/projects/cvis/testsurvey2.html>

Email address: (not required)

Current Date (UTC) (mo/day/yr):

Current Time (UTC) (eg. 0900, 1000, 1100):

Please utilize surface observations and satellite data in the evaluation of this product. Surface observations can be found on the product page <http://www.rap.ucar.edu/~paddy/cvis3> and satellite data can be found at <http://www.rap.ucar.edu/weather/satellite>. The system provides past forecasts of C&V valid at the current analysis time. This allows for simultaneous evaluation of the analyses and forecasts being produced by the system.

1. Please indicate what site you are including in this evaluation.

ENTIRE SOCAL DOMAIN

2. How would you categorize southern California at this time, in terms of low ceilings and visibilities?

1-widespread low C&V (Ceiling < 3000 ft.: Vis < 5 mi.)

Comments:

3. What is the observed ceiling (ft) and visibility (mi) at the evaluation site? If you are evaluating the "entire SOCAL domain," please indicate the *minimum* observed ceiling and visibility within the domain.

Ceiling: less than 200 ft Visibility: less than 0.5 mi

4. If the ceiling is less than 3000 ft and/or visibility is less than 5 mi, what is the major cause of the low ceilings or visibilities? (e.g. marine stratus, fog, haze, etc.)

5. If the ceiling is less than 3000 ft and/or visibility is less than 5 mi, how long has the event persisted?

☐ less than 2 hours ☐ 2-5 hours

☐ 5-8 hours ☐ 8-12 hours

☐ greater than 12 hours ☐ unknown

6. Using a scale of 1-5, where 1 is poor and 5 is excellent, how would you rate the performance of the ceiling and visibility analyses at the evaluation site?

	1	2	3	4	5
Ceiling Analysis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Visibility Analysis	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Ceiling and Visibility Evaluation Form - Microsoft Internet Explorer

Address: <http://www.rap.ucar.edu/projects/cvis/testsurvey2.html>

7. In what ways did the analyses from the C&V algorithm differ from the actual event in question? (Check all that apply)

	Location	Values too high	Values too low	Other	Differences were negligible
Ceiling Analysis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Visibility Analysis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments:

8. Using a scale of 1-5, where 1 is poor and 5 is excellent, how would you rate the performance of the ceiling and visibility forecasts at the evaluation site?

	1	2	3	4	5
Ceiling Forecasts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Visibility Forecasts	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

9. In what ways did the forecasts from the C&V algorithm differ from the actual event in question? (Check all that apply)

	Location	over-forecast (values too high)	under-forecast (values too low)	Timing	Other	Differences were negligible
1-hr. ceiling forecast	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3-hr. ceiling forecast	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6-hr. ceiling forecast	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1-hr. visibility forecast	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3-hr. visibility forecast	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6-hr. visibility forecast	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments:

10. Please list any trends (e.g., algorithm over-forecasts C&V, under-forecasts C&V, etc.) that you have identified.

Other comments:

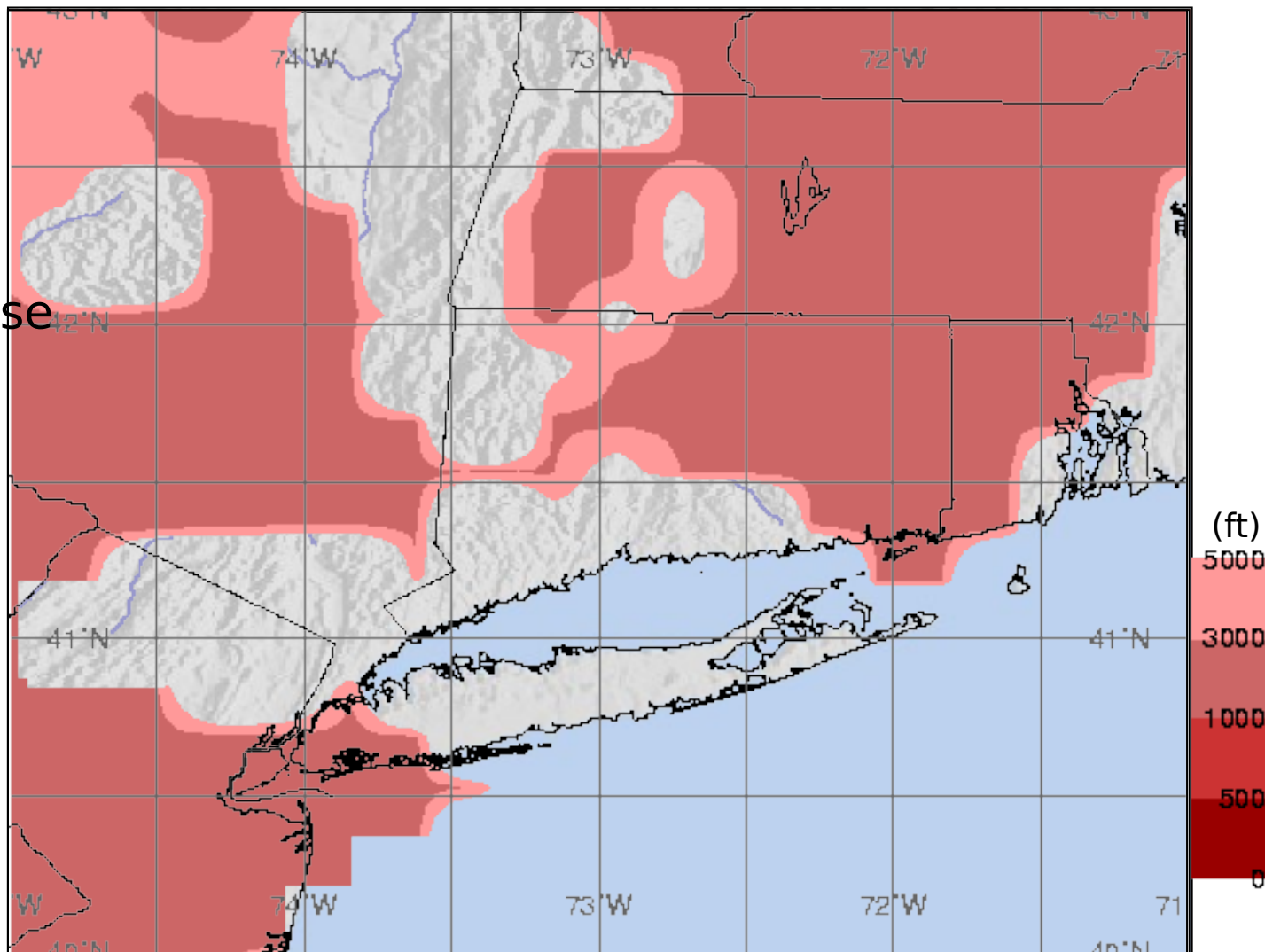


Nowcast Web-Based Ceiling Height Layered Product Design

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Applicability

- STW
 - TACAIR
 - TLAM
- CVN Case Wx
- Area Air Defense
- Helo Aviation
 - ASW
 - AMW
 - AMCM
 - OTHT
 - Logistics



Ceiling, visibility or flight category layered product



Satellite Visible and IR Data

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Applicability

- CVN Case Wx

- Missile

Launches

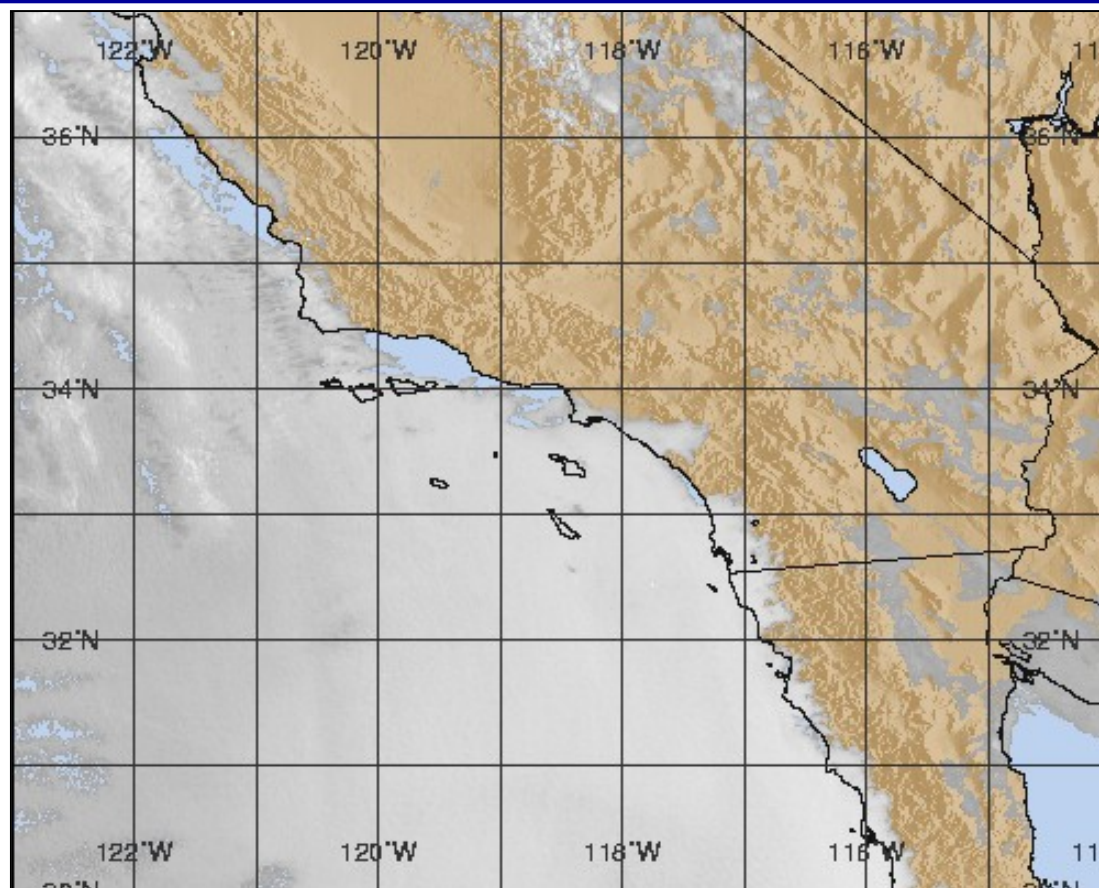
- EM/EO

- Surveillance
- FC Radar
- Comms
- Ducting
- I&W

- Area Air

Defense

- Helo Aviation
- ASW
- AMW
- AMCM
- OTH
- Logistics
- Navigation



- Data available from server on NRL FMQ-17 (Terascan) system

- 15 min update rate



NEXRAD Radar Data

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Applicability

- CVN Case Wx

- Missile

Launches

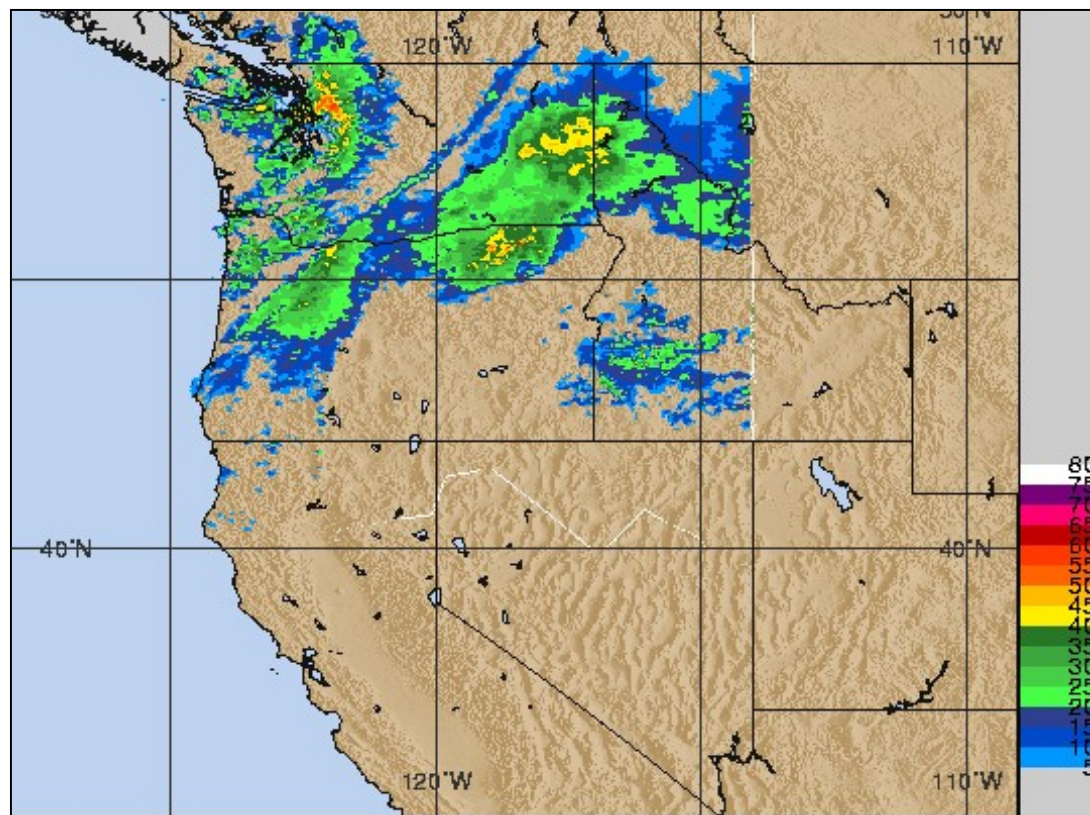
- EM/EO

- Surveillance
- FC Radar
- Comms
- Ducting
- I&W

- Area Air

Defense

- Helo Aviation
- ASW
- AMW
- AMCM
- OTHT
- Logistics
- Navigation



- Data available from NOAAPort and on NOAA anonymous ftp site
- Example composite of nine radars
- 10 min update rate

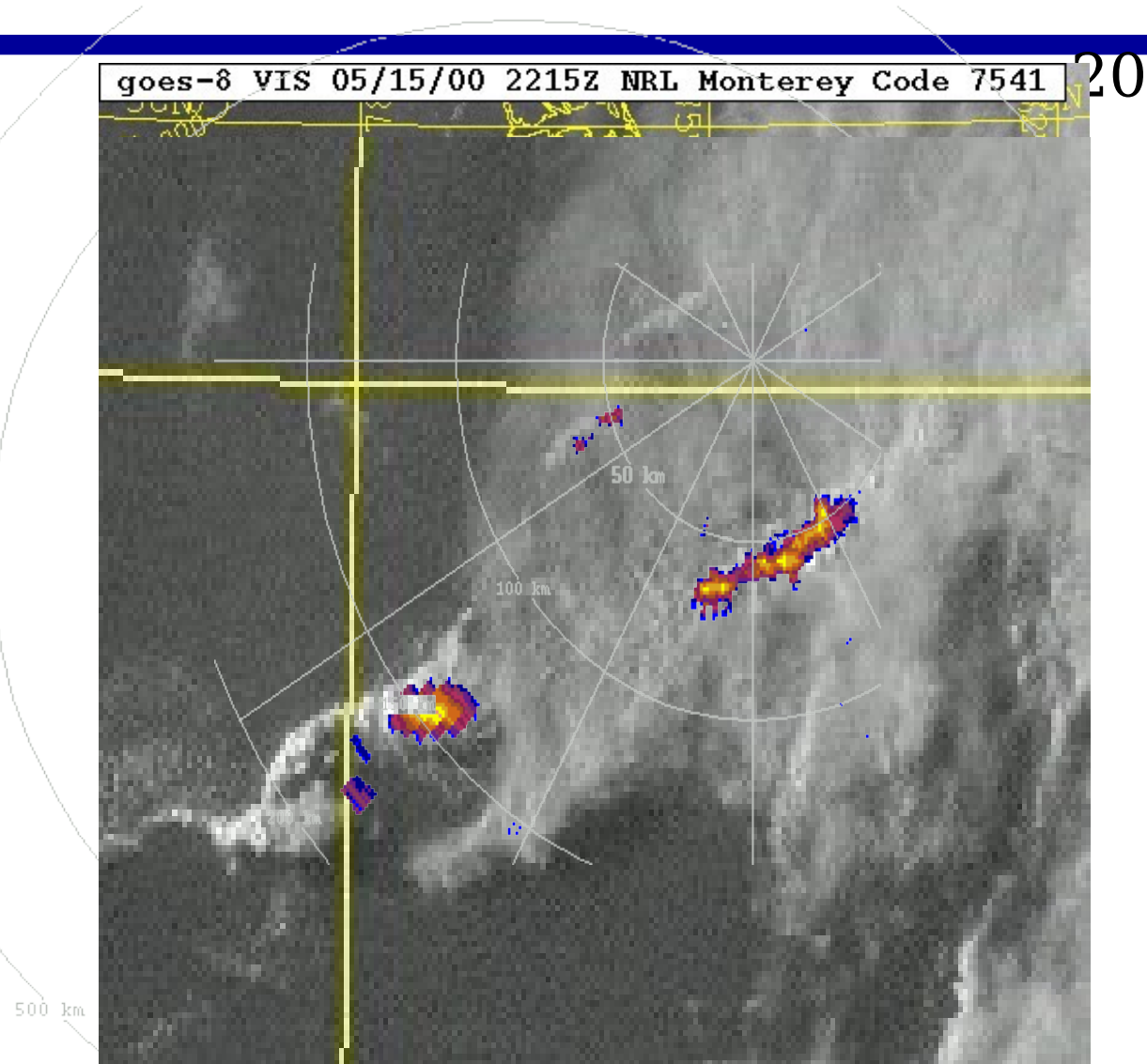


Radar Combined with Satellite

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Applicability

- CVN Case Wx
- Missile Launches
- EM/EO
 - Surveillance
 - FC Radar
 - Comms
 - Ducting
 - I&W
- Area Air Defense
 - Helo Aviation
 - ASW
 - AMW
 - AMCM
 - OTH
 - Logistics
- Navigation Safety



**Embedded thunderstorms
approaching the battlegroup**

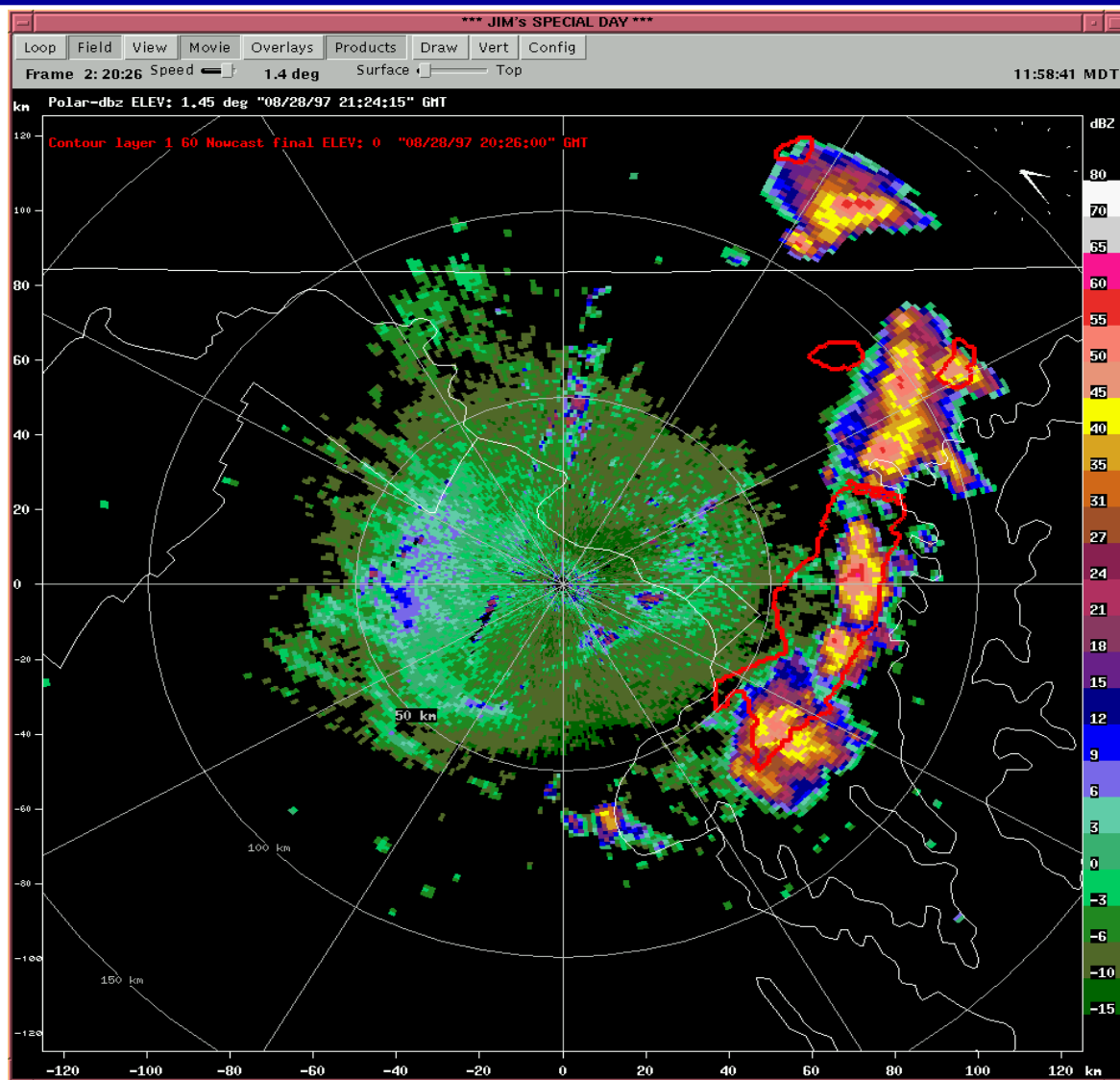


Thunderstorm Autonowcaster

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Applicability

- CVN Case Wx
- Missile Launches
- EM/EO
 - Surveillance
 - FC Radar
 - Comms
 - Ducting
 - I&W
- Area Air Defense
 - Helo Aviation
 - ASW
 - AMW
 - AMCM
 - OTH
 - Logistics
- Navigation



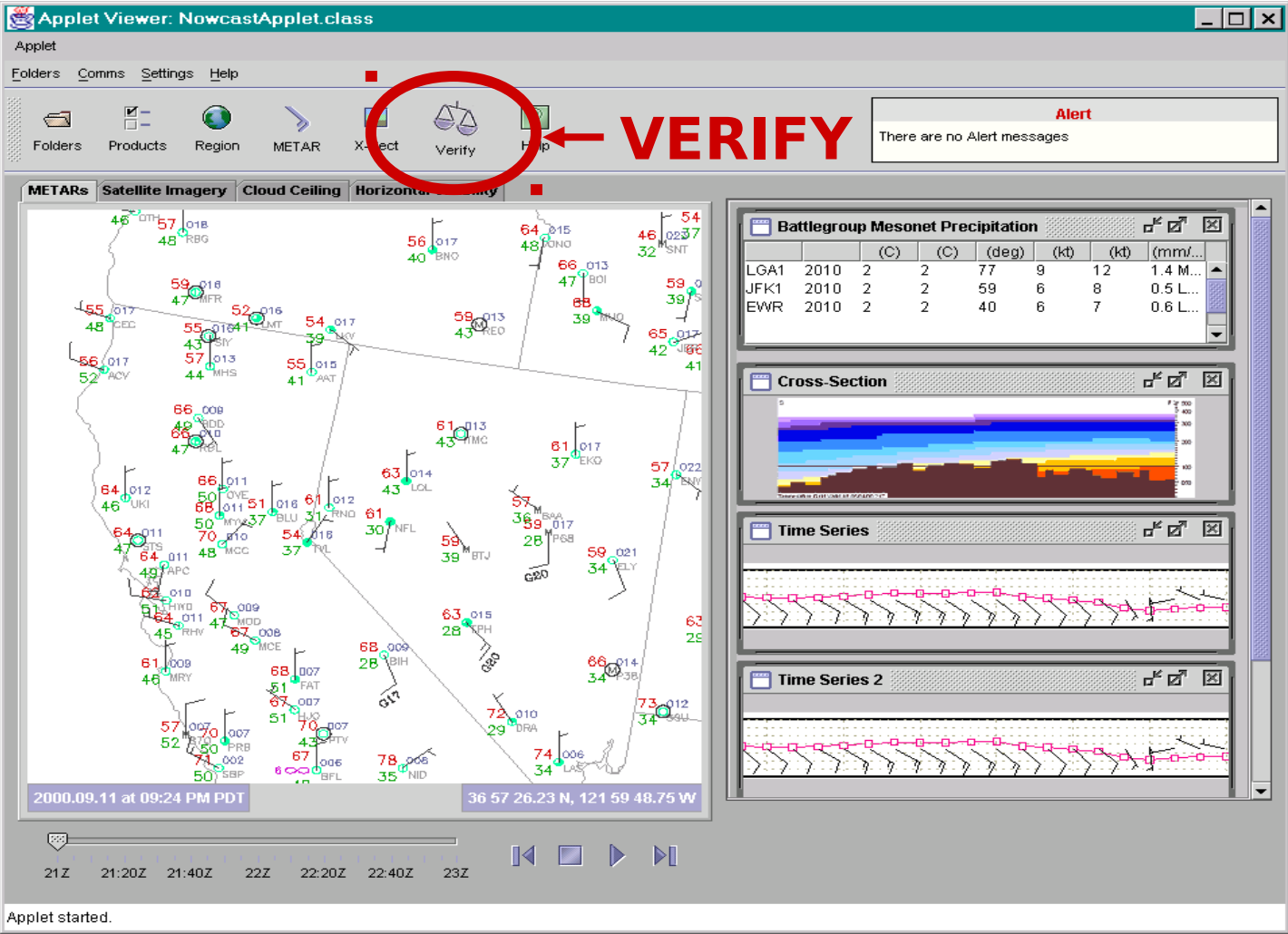
One-hour forecast (red) and automatic verification



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Ultimate Goal: Each Nowcast product will have a verification product and running “confidence level” associated with it



Error Threshold Monitoring using Stoplight Display

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NOWCAST VERIFICATION

COAMPS

Confidence Level for Last 6 Hours: Friday 21Z 18 MAY 2001

Product	Error Threshold	T - 5h	T - 4h	T - 3h	T - 2h	T - 1h	NOW
Wind Speed	5 kt	CAUTION	CAUTION	CAUTION	MISSING	CAUTION	CAUTION
Wind Direction	90 deg	WARNING	WARNING	WARNING	MISSING	WARNING	WARNING
Temperature	10 deg C	CAUTION	CAUTION	CAUTION	MISSING	CAUTION	CAUTION
Relative Humidity	20 percent	WARNING	WARNING	WARNING	MISSING	WARNING	WARNING
Dewpoint Temperature	10 deg C	WARNING	WARNING	WARNING	MISSING	OKAY	CAUTION

RED: Warning (>2X), YELLOW: Caution (>1X), GREEN: Okay (<1X), GRAY: Missing

- All products within a user's folder
- All the stations within a product, or a group of selected stations within a specified area of interest, or for one specific station
- Web-based, drill down capability
 - Color coded difference maps with station plots
 - Historical time series; Vertical profiles

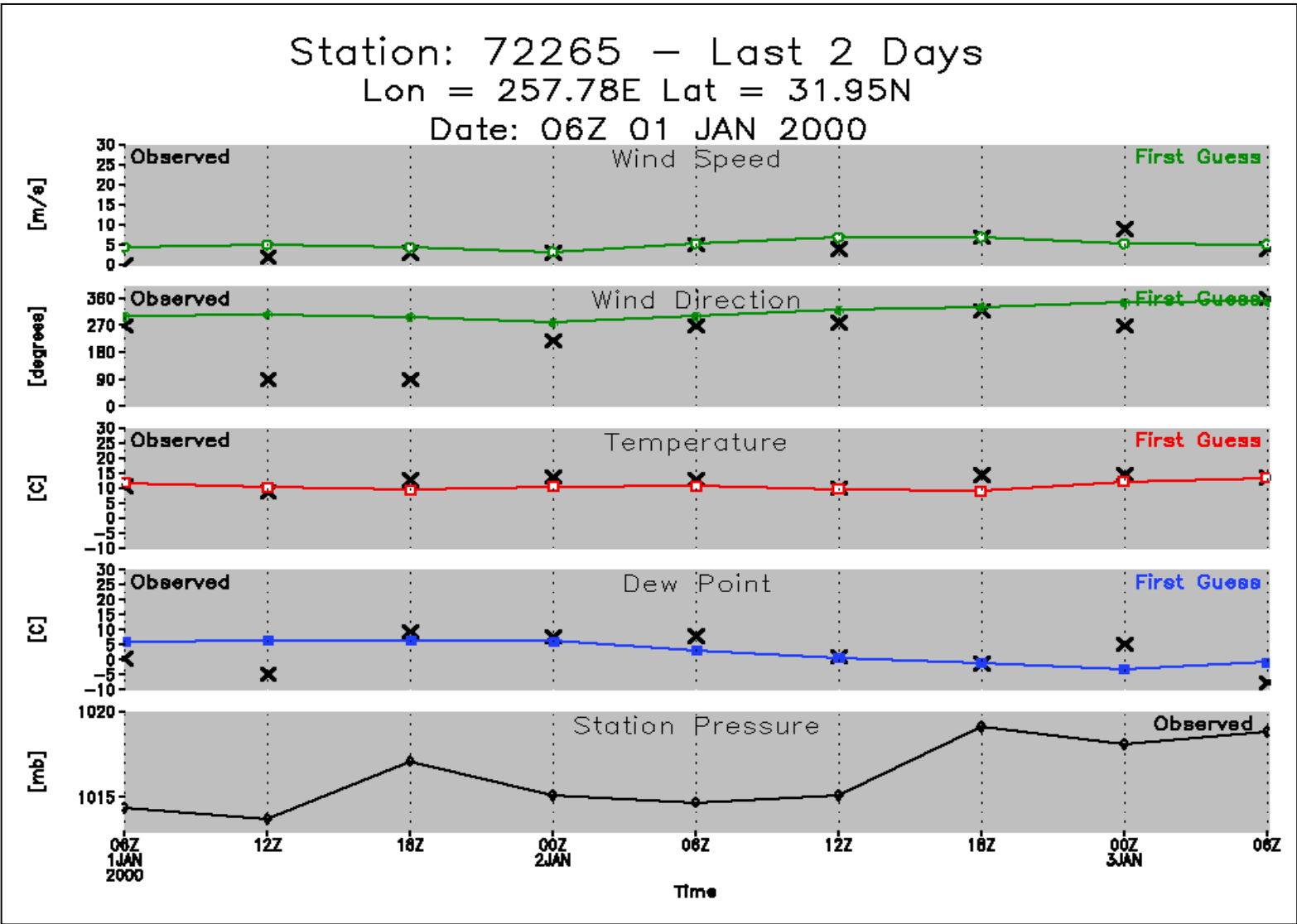
Black listing of "bad" stations, parameters, or



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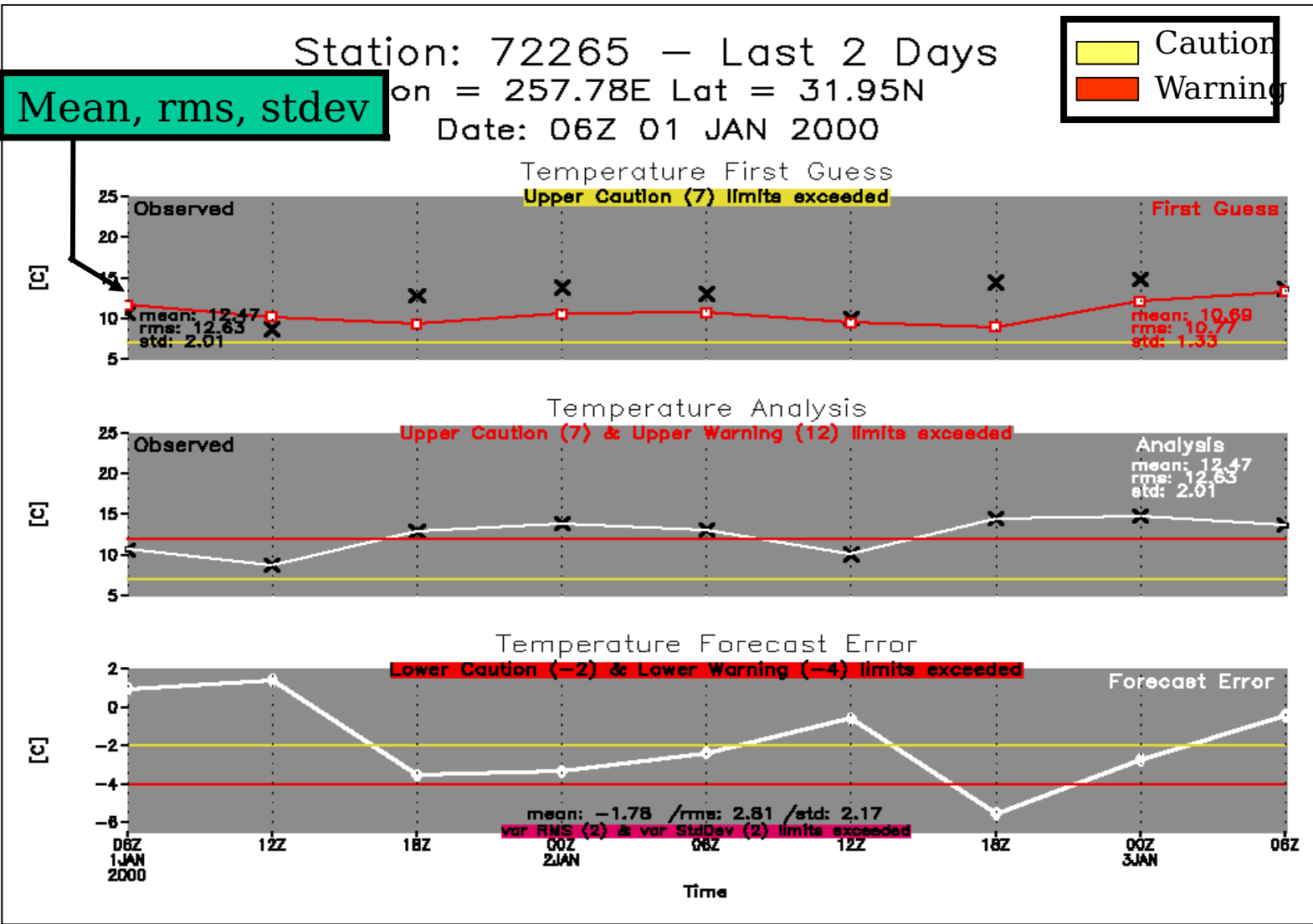
Time series for multiple parameters



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Time series with statistics and threshold alerts

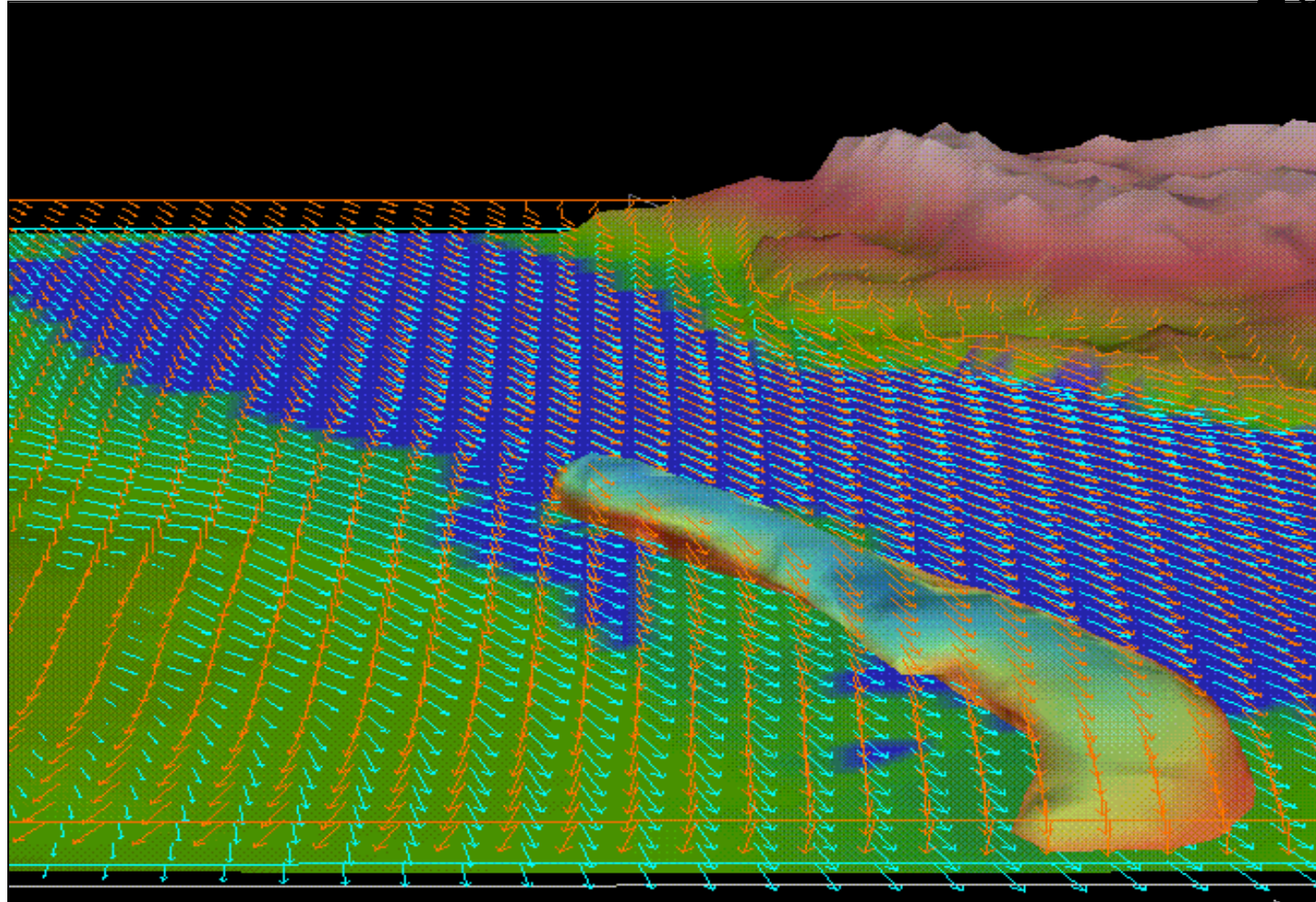


High-Resolution Winds Drive Chem/Bio Models

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Applicability

- CVN Launch and Recovery
- STW
- Missile Launch
- Helo Aviation
 - ASW
 - AMW
 - AMCM
 - OTHT
 - Logistics
- WMD
 - JWARN



**Proposal submitted to Joint Science and
Technology Panel for Chemical and Biological
Defense**

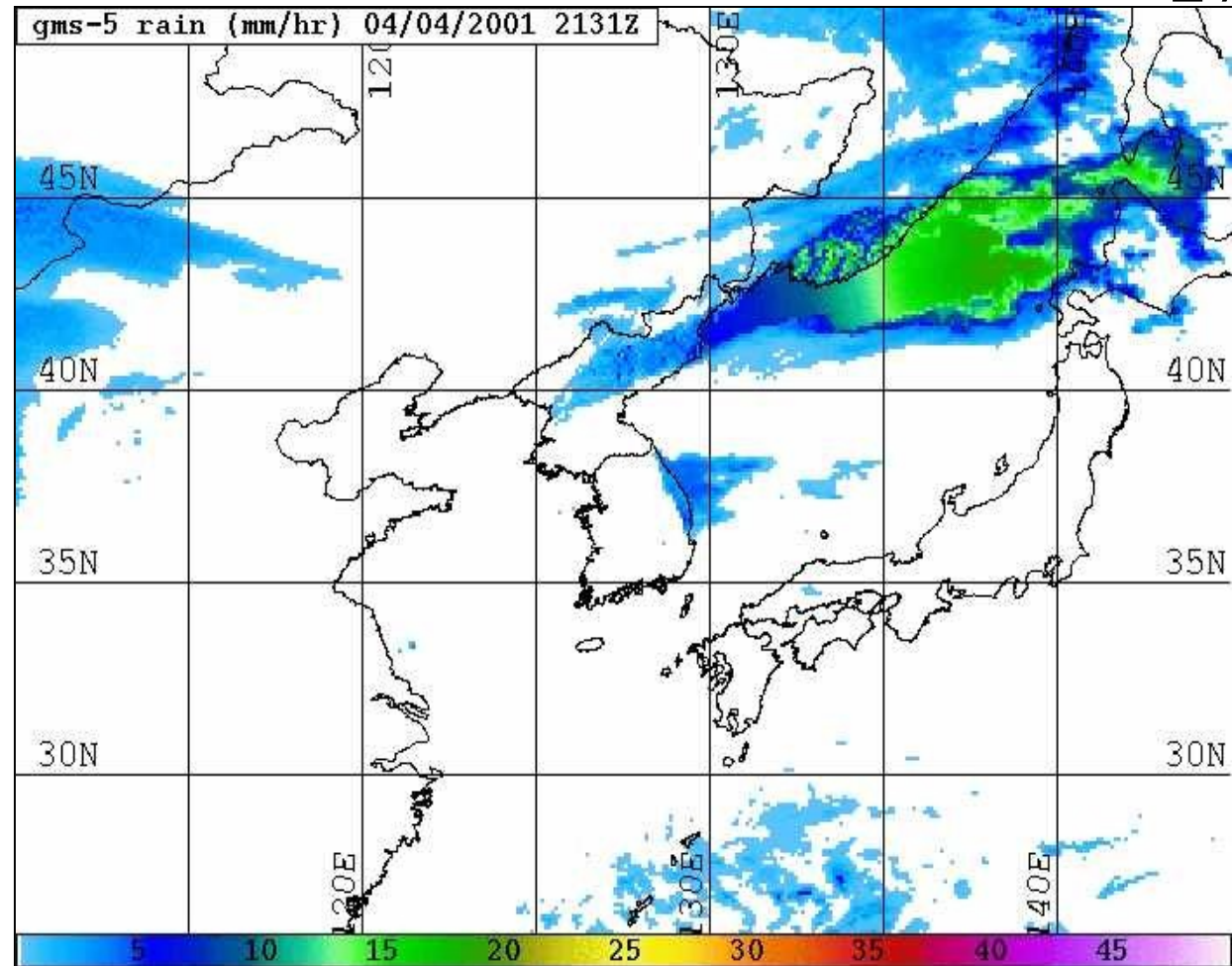


Satellite Target Area Rain Rate Display

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Applicability

- Ship To Objective Maneuver (STOM)
- Logistics Over The Shore (LOTS)
- Trafficability



Continuous satellite rain rates may be improved with TEP data



Meteogram Time-Height Display

Applies to a Specific Target Location

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Applicability

- STW
 - Tactics
 - Weapons Selection
 - BDA
- EM/EO
- C4ISR
- SOF

Wind Barbs (kts)
Temperature (F)
RH > 70%
Freezing level

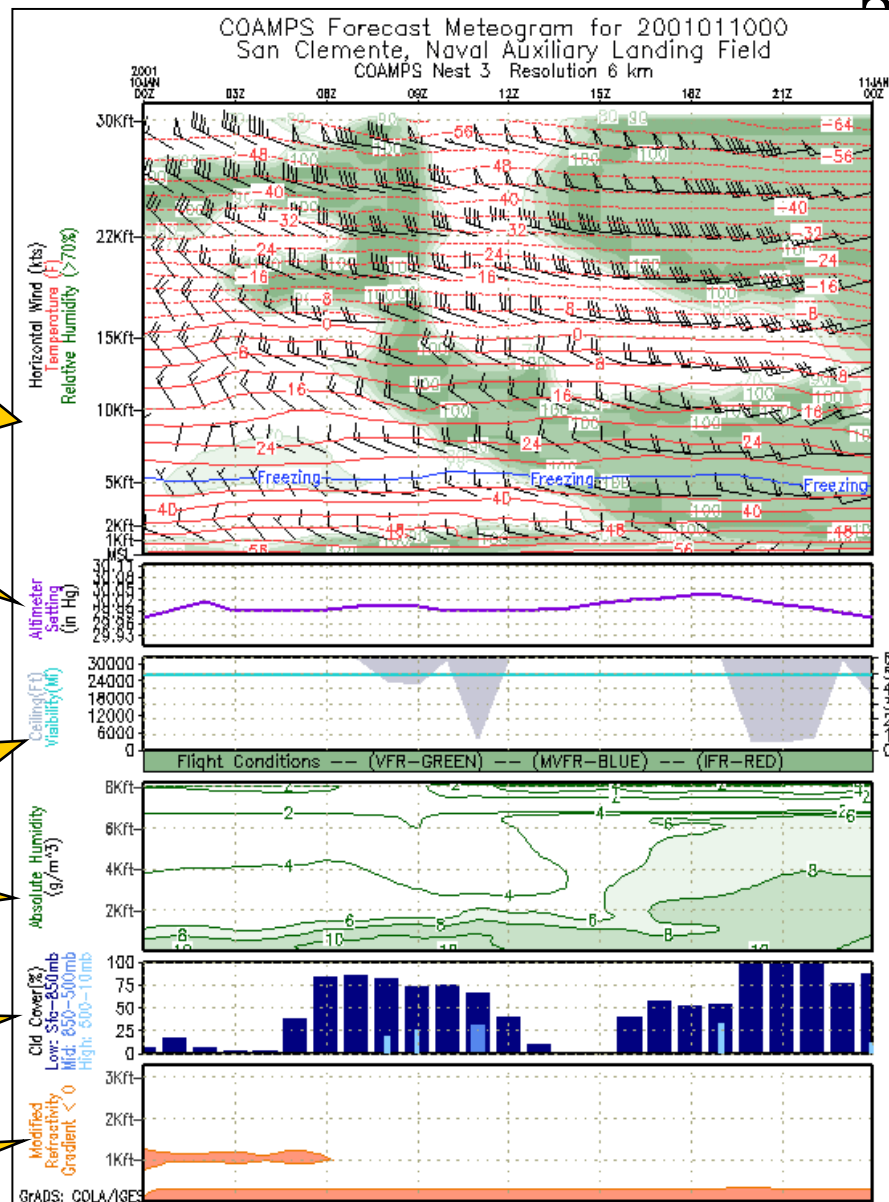
Altimeter Setting (in Hg)

Ceiling Height (ft)
Visibility (mi)
Flight Category

Absolute Humidity
(g/m**3)

Layer Cloud Coverage (%)

Trapping Layer Altitudes
(ft)



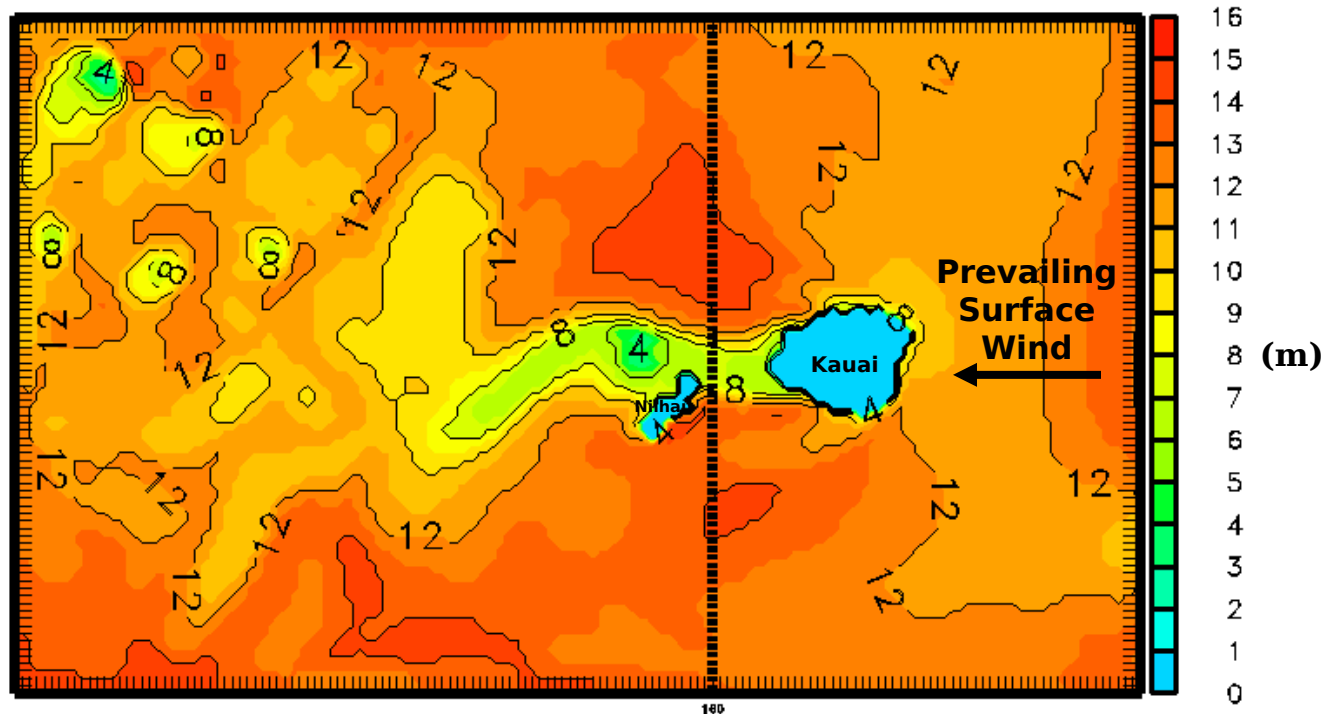


Evaporation Duct Height

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Applicability

- EM
 - SPY FTR
 - Surveillance
 - I&W
- Area Air Defens
 - Low Flyer
- Comms
- ESM



Modeled evaporation duct height in the lee of Kauai

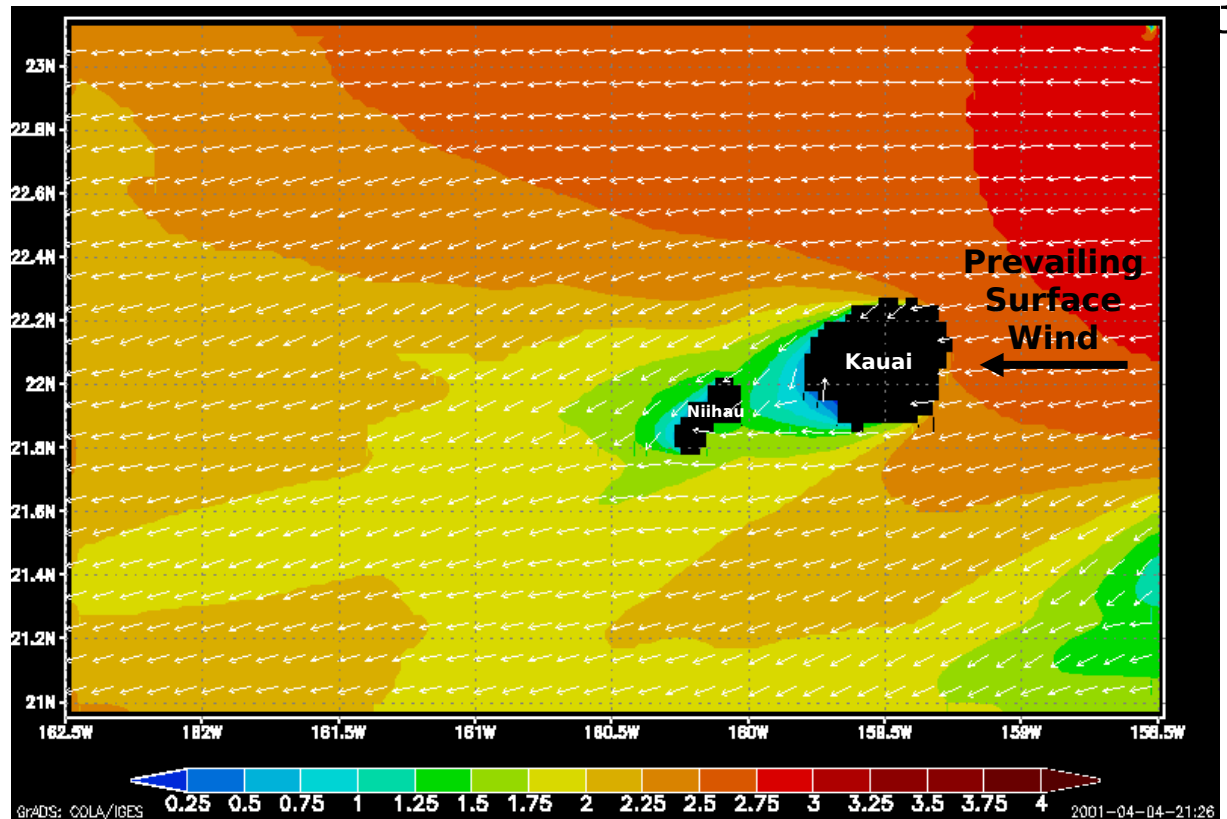


Wave Height and Direction

30

Applicability

- Sea State
 - Well Deck Ops
 - Small Boat Ops
 - SOF
 - EOD
 - AAV
 - Landing Craft
 - Unrep
- ASW Ops
 - Helo
 - Tail
 - Acoustic Sensors
 - Non-Acoustic Sensors
- Missile Launches



Wave height and direction around Kauai

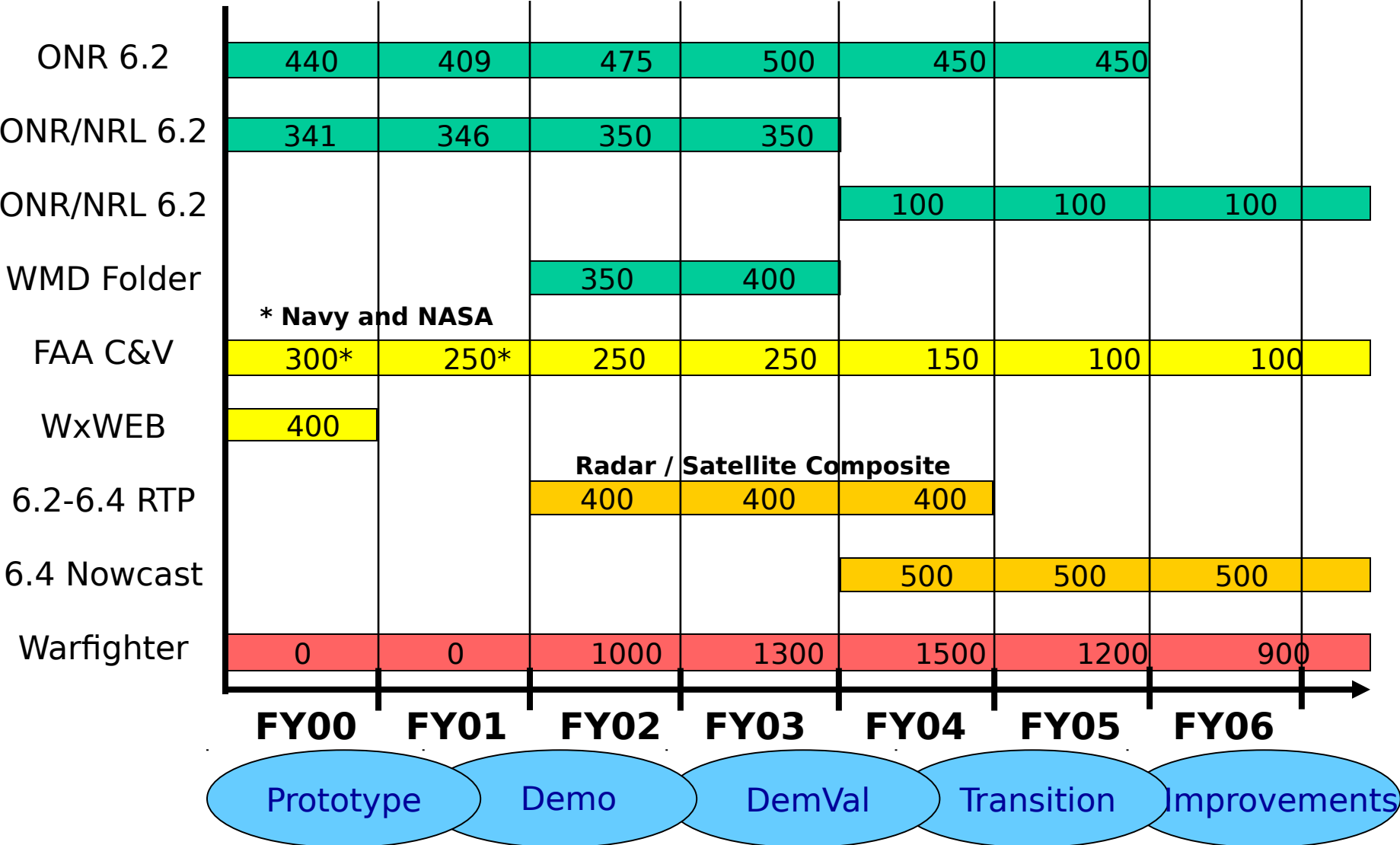


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R&D

\$K 31





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FAQ
IPT Forum
Demo
Downloads
Tech Support

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FOR THE NEXT GENERATION NAVY NOWCAST

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NRL Monterey Marine Meteorology Division (Code 7500)

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[Dr. Merilees](#),
Superintendent

Technical POC:
[John Cook](#)

[Webmaster](#)

Last Updated: 19FEB01

Satellite Winds

Cloud Imagery

Satellite Rain Rate

TEP Weather Radar

UAV Weather Data

Target Area Weather Data

Weather Observations

Dust and Pollution Data

Weather Forecast Model

NOWCAST
3D "snapshot" of weather around the battleship and target areas

Nowcast for the Next Generation Navy is a project at the Naval Research Laboratory (NRL) to develop a nowcasting system (called Nowcast) for the Navy. The development of the Nowcast system is sponsored by the Office of Naval Research (ONR), with contributions from the Oceanographer of the Navy (Space and Naval Warfare Systems Command and the Commander, Naval Meteorology and Oceanography Command), the National Aeronautics and Space Administration (NASA), and the Federal Aviation Administration (FAA).

The complexity of the naval battlespace necessitates the automated fusion of environmental information to maintain a consistent database of the Virtual Natural Environment (VNE). The battleship of today has limited capability to sample the environment, has no capability to efficiently fuse the sparse information that is available, nor does it have the ability to share a common, consistent representation of the VNE among its components.

The Nowcast system is being developed with input from an Integrated Product Team (IPT) to provide the organic battleship VNE database and end-user products based on the data. The Nowcast system is an enterprise-class, network-centric, data fusion system that will allow the forward-deployed battleship to automatically and continuously fuse meteorological data from available sources to characterize the battlespace environment.

<http://www.nrlmry/navy.mil> **Link to Research Pro**